wherein said object to be heated is 5 to 5000 μm apart from the surface or the heating surface of said ceramic substrate.

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REMARKS

Favorable reconsideration of this application in light of the present amendment and the following discussion is respectfully requested.

Claims 1, 2, 4, 5, 13, and 14 are presently active in this application, Claims 3 and 6-12 having been previously withdrawn from consideration, Claim 4 having been amended, and Claim 14 having been added by the present amendment.

In the Official Action Claims 1, 2, 4, 5, and 13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawanabe et al (U.S. Pat. No. 6,133,557) in view of Muka (U.S. Pat. No. 5,854,468) or Tamagawa et al (U.S. Pat. No. 5,777,838).

Firstly, Claim 4 has been amended solely to remove the improper dependence of Claim 4 from another multiply dependent claim.

Secondly, Applicants respectfully submit that Claims 1, 2, 4, 5, and 13 are not obvious in view of the applied prior art.

Independent Claim 1 defines a ceramic heater having a ceramic substrate, on a surface of which or inside which, a heating element is formed. Above the ceramic heater, there exists a structure such that an object to be heated can be ***held apart*** from a surface of the ceramic substrate and heated. Similarly, independent Claim 2 defines a ceramic heater having a structure such that a face of the ceramic substrate on which no heating element is formed or one face of the ceramic substrate is made to be a heating surface, and an object to be heated can be ***held apart*** from the heating surface and heated.

Ceramics are generally known in the art to be low in thermal conductivity compared to metals. Thus, when an object to be heated is brought into contact with a ceramic substrate and heated, the object to be heated obtains a temperature distribution similar to that of the ceramic substrate itself. For this reason, an uneven temperature distribution on a ceramic substrate heater is mimicked on the object to be heated, and the object to be heated is not heated uniformly, as disclosed in Applicants' Comparative Example 1 of the specification.[2]

Furthermore, ceramics contain impurities such as for example materials added to the ceramic powder during the ceramic sintering process. If a semiconductor wafer is the object to be heated, then the impurities in the ceramic can diffuse into the semiconductor wafer and contaminate the wafer, as also disclosed in Applicants' Comparative Example 1 of the specification.

Applicants' specification states that:

> By setting the semiconductor wafer and the ceramic substrate into the state that they ***do not contact*** each other, it is possible to attain the condition that the semiconductor wafer is not affected by temperature distribution of the surface of the ceramic substrate. Thus, the temperature of ***the whole of the semiconductor wafer*** can be made uniform. Upon heating, the heat of the ceramic substrate is conducted to the semiconductor wafer by a convection of the air or radiation. Since the ceramic substrate and the semiconductor wafer do not contact each other, an advantageous effect that: impurity elements, such as Na, B and Y, contained in the ceramic substrate or sintering aids do not contaminate the semiconductor wafer; is also obtained.[3] [emphasis added]

Accordingly, in Claims 1 and 2, the object to be heated is held apart from the ceramic substrate, thus minimizing impurity contamination and producing a more even "in-plane" temperature distribution than would occur if the object to be heated contacted the ceramic substrate surface.

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[2]Specification, page 27, lines 2-12.

[3]Id., page 7, lines 1-13.

Applicants' Test Examples 1, 2, and 3 illustrate the advantages of the ceramic heater defined in Claims 1 and 2 by showing temperature differentials across a heated silicon wafer as low as 3°C and the absence of yttrium (Y) contamination. Thus, more uniform heating without impurity contamination is realized in ceramic heaters such as those defined by independent Claims 1 and 2.

Kawanabe et al address a similar problem to that of the present invention in that an object is heated by a ceramic substrate heater. However, Kawanabe et al provide no teaching for a structure which can hold a wafer from the ceramic substrate heater, as acknowledged in the outstanding Office Action.[4] Rather, in Kawanabe et al, the wafer to be heated is placed in direct contact with the ceramic substrate heater, as is evident from Figures 4-6 of Kawanabe et al. Thus, it can be understood that the heater structure in Kawanabe et al corresponds to Applicants' Comparative Example 1, and consequently suffers from the aforementioned non-uniformity and impurity problems.

Muka also addresses a problem of heating an object, but uses a different approach from Kawanabe et al or the present invention in that Muka utilizes a metallic substrate heater, not a ceramic substrate heater. Muka discloses that the heater plate 36 is preferably made of copper.[5] Furthermore, when one of ordinary skill in the art considers the heat expansion rate and the high temperatures employed on the heater of Muka, the heater plate 36 needs to be made of metal in order to match the concomitant expansion of the heater plate 36 to the heat distribution plate 50, also preferably made of copper.[6] Moreover, since a metal substrate heater has a higher thermal conductivity than one made of ceramic, there is no concern in

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[4]Office Action, page 3, lines 3-4.

[5]Muka, column 2, line 65.

[6]Muka, column 2, lines 63-67.

Muka for a poor temperature differential on the heater surface will be mimicked on the object to be heated.

Tamagawa et al address a different problem than that of the present invention in that Tamagawa et al address a method of attracting a wafer to an electrostatic cooling chuck. While Tamagawa et al disclose an electrostatic chuck provided with a plurality of fine projections formed on the surface of dielectric member, the electrode 14 in Tamagawa et al is not a heater element, rather it is an electrode used to apply a Coulomb force to the associated electrostatic chuck 10.[7] As such, heating of an attracted wafer is of no concern to Tamagawa et al. Indeed, the convex portions (i.e., the fine projections 28) are used for cooling the substrate, not heating. Tamagawa et al disclose:

> . . .Accordingly, the conduction of heat is very small between the wafer W and the dielectric member 12, and the cooling gas only comes into the substantial contact with the wafer W except the surface of the wafer W on the side being treated. Therefore, even if there exists a temperature distribution in the dielectric coat, the wafer W is uniformly ***cooled by the cooling gas*** without being affected by the temperature distribution in the dielectric member 12.[8] [emphasis added]

As such, the electrostatic cooling chuck of Tamagawa et al has no heater function.

The Office Action asserts that it would be obvious to one of ordinary skill in the art to adapt Kawanabe et al with the heater support of Tamagawa et al or Muka.[9] Applicants traverse the obviousness rejection in that the teachings of Tamagawa et al or Muka are not properly combinable with the teachings of Kawanabe et al.

Firstly, since Tamagawa et al relates to an electrostatic cooling chuck on which a semiconductor wafer is held and cooled and has no heater support, it is not clear what

[7]Id., column 4, lines 62-66.

[8]Tamagawa et al, column 5, line 67, to column 6, line 8.

[9]Office Action, page 3, lines 11-14.

motivation one of ordinary skill in the art would have to adapt a wafer heater of Kawanabe et al with the electrostatic cooling chuck of Tamagawa et al. As such, the teaching of Kawanabe et al and Tamagawa et al are opposite in purpose, and the proposed modification to Kawanabe et al (i.e providing a heater with a cooling plate) renders Kawanabe et al unsatisfactory for its intended purpose of heating. Therefore, it is not appropriate to combine the electrostatic cooling chuck of Tamagawa et al with the heater plate of Kawanabe et al. See M.P.E.P. §2143.01.

Secondly, Muka addresses a different problem than addressed in the present invention or in Kawanabe et al in that Muka addresses a problem of uniformity in a temporal heating rate. That is, Muka provides a uniform temporal temperature ramp made repeatable by wafer support projection pins 46.[10] Thus, the rationale for separating a wafer from the metallic heater plate in Muka is different than the rationale for separating a wafer from the ceramic substrate heater of the present invention.

Since neither Muka nor Kawanabe et al recognize the impurity contamination problem or the in-plane uniformity problem addressed by Applicants' invention, it is respectfully submitted that there exists no motivation for one of ordinary skill in the art to adapt the ceramic substrate heater of Kawanabe et al to have the projection pins of Muka. Furthermore, since the impurity contamination problem associated with contacting an object to be heated to a ceramic substrate heater was not known prior to Applicants' invention, only impermissible hindsight offered by the present invention provides one of ordinary skill in the art with a

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[10] The heater assembly of Muka is generally used in an open loop control system as specified therein. As such, heating time is an important and directly related to the temperature of the object being heated.

motivation (albeit an improper one) to adapt the ceramic substrate heater of Kawanabe et al to have the projection pins of Muka.

Therefore, there exists no suggestion or motivation in the applied prior art for one of ordinary skill in the art to combine the ceramic substrate heater of Kawanabe et al with the mounts of Muka in order to hold apart an object to heated from a heating surface of a ceramic substrate, as defined in Claims 1 and 2.

Thus, it is respectfully submitted that independent Claims 1 and 2 and Claims 4, 5, 13, and 14 which depend therefrom are not obvious and patentably define over the applied prior art.

Consequently, in light of the present amendment and in view of the above discussions, the outstanding grounds for rejection are believed to have been overcome. This application as amended is believed to be in a condition for formal allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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IN THE CLAIMS

Please amend Claim 4 as shown below:

4. (Amended) The ceramic heater according to [any of] claim 1[,] or 2[, or 3], wherein said object to be heated is 5 to 5000 μm apart from the surface or the heating surface of said ceramic substrate.

14. (New)